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This would not be unexpected; but secondary fringes, or something else in the field, seem to remain stationary. Successive fields may be quite different as to arrangement of fine and coarse lines, but all plane gratings exhibit the same phenomena. Thus it is obvious that the fringes of the present paper result from a residual irregularity in the rulings of the grating. Micrometrically, the successive strips of a slit image, however fine, are of unequal intensity. Between these there is diffraction as may be tested by examining the clear glass at the edge of the ruled space.

It is obvious that in the otherwise indistinguishable images of a slit in homogeneous light, however sharp or however narrow, in its own focal plane the nature of its origin still persists and may be detected by observations outside of the principal focal plane. A fine slit is in all cases presupposed and all the phenomena vanish for a wide slit. On the other hand the width of the pencils of parallel rays may be far greater than is necessary to show the strong Fraunhofer lines.

A fuller report of this work has been presented to the Carnegie Institution of Washington, D. C.

THE EFFECT OF PARENTAL ALCOHOLISM (AND CERTAIN OTHER DRUG INTOXICATIONS) UPON THE PROGENY IN THE DOMESTIC FOWL

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The investigation here reported deals with the general problem of the origin and causation of new, heritable variations. That this is one of the most fundamental problems of genetics admits of no doubt. The method by which this general problem is attacked in the present investigation is that of exposing systematically the germ-cells of an animal to something unusual or abnormal in the surrounding conditions, and then analyzing, so far as may be, not only the new heritable variations themselves (provided any such appear), but also the factors which underlie their causation.

The specific problems with which this investigation deals are these:

1. Does the continued administration of ethyl alcohol (or similar narcotic poisons) to the domestic fowl induce precise and specific changes in the germinal material, such as to lead to new, heritable, somatic variations?

2. Failing a specific effect is there a general effect upon the germinal material leading to general degeneracy of the progeny?

3. What in general are the effects upon the soma of the treated individual of the continued administration of such poisons?

4. Are the somatic effects upon the treated individuals of a sort to give any clue to the probable origin, or mechanism of the germinal changes?

The present paper reports, in brief abstract, the results obtained from the beginning of the experiment in September, 1914, to February 1, 1916. A complete report is now in process of publication in another place. In that report the data will be presented in detail, with probable errors, etc.[1]

The foundation stock used in these experiments came from pedigreed strains of two breeds of poultry, Black Hamburgs and Barred Plymouth Rocks. Both of the strains used have been so long pedigree-bred by the writer, and used in such a variety of Mendelian experiments, that they may be regarded as 'reagent strains,' whose genetic behavior under ordinary circumstances may be predicted with a degree of probability amounting practically to complete certainty. Furthermore, the results of crossing these two breeds reciprocally have been thoroughly studied by me.

Three different series of birds were started. To the birds in one series was administrated 95% ethyl alcohol. To those in the second series was administered methyl alcohol, and to those in the third series, ether.

The method followed in these experiments for the administration of the poisons was essentially that which has been used by Stockard,[2] namely the method of inhalation.

The number of treated birds used in the experiments to the date covered in this report is 19. The number of untreated control brothers and sisters is 58.

Results in the treated individuals.—Before entering upon any discussion of the effect of the alcohol treatment on the progeny it seems desirable to examine the effects, both structural and physiological, upon the treated individuals themselves. The main results are summarized in Table I.

The plan of this table is as follows: In the last column of the table a plus sign denotes that, with reference to the particular character discussed, the alcoholists have been favorably affected; a minus sign that they have been unfavorably affected as compared with untreated

TABLE I

SHOWING IN SUMMARY FORM THE EFFECT OF CONTINUED ADMINISTRATION OF ALCOHOL (ETHYL AND METHYL) AND ETHER, BY THE INHALATION METHOD, UPON THE TREATED INDIVIDUALS THEMSELVES

CHARACTER OR QUALITY STUDIED	TREATED INDIVIDUALS	UNTREATED CONTROLS	NET RESULTS ON ALCOHOLISTS
1. Mean number per bird of consecutive days of treatment	344.2	0	
2. Net percentage mortality (to Feb. 1, 1916) exclusive of birds accidentally killed	*0*	41.0	+
3. Mean body weight of females (in gms.)	3266	*2953*	—
4. Mean egg production per bird, 14 months	183.97	180.80	0
5. General activity	Reduced	*Normal*	—
6. Sexual activity	Reduced	*Normal*	—

controls. A zero indicates that no effect of the treatment, one way or the other, has beeen detected.

From these summarized data it is possible to gain a tolerably clear comprehension of the objective happenings in these experiments so far. The treated animals themselves are not conspicuously worse or better than their untreated control sisters or brothers except in respect to mortality rate. This is much lower in the treated than in the concontrols.

Regarding egg production the following details may be mentioned.

The egg production of the treated birds and the untreated controls was entirely normal in respect of its seasonal distribution, as well as in regard to its amount.

There has been *no significant difference* in the egg production of the treated birds and their untreated control sisters, either in the total average number of eggs produced per bird, nor in the seasonal distribution of this production. The only conclusion which can be drawn from the statistically insignificant differences which appear between treated and control birds is that the inhalation treatment has not affected the egg production of the birds, either favorably or adversely.

Results in the F_1 progeny of treated individuals.—The general plan of the matings in 1915 was to breed a treated male of each of the three classes, ethyl, methyl, and ether with (*a*) untreated control females, and with (*b*) treated females of his own class (i.e., ethyl ♂ × ethyl ♀, methyl ♂ × methyl ♀, ether ♂ × ether ♀). In addition to these matings an untreated control male was mated with (*a*) untreated control females (*b*) ethyl females, (*c*) methyl females, and (*d*) ether females.

All of the matings were of the type Black Hamburg ♂ × Barred

Plymouth Rock ♀. There were produced 234 chicks from matings wherein one or both parents were treated.

The following reasoning has been used in devising a numerical expression of the dosage, so far as concerns the progeny. Two germ cells, a sperm and an ovum, unite to form the zygote of each progeny individual. It is proposed to designate as the 'total germ dosage index' the total number of days during which the two gametes making the offspring zygote have been exposed to alcoholic influence while sojourning in the body of the treated individuals.

The total germ dosage index for the F_1 progeny in these experiments ranges from 130 days to 354 days, with the matings for the different substances used well scattered over the range. A summarized statement of the effects on the progeny is given in Table II.

TABLE II

SHOWING IN SUMMARY FORM THE EFFECT OF CONTINUED ADMINISTRATION OF ALCOHOL (ETHYL AND METHYL) AND ETHER BY THE INHALATION METHOD, UPON THE PROGENY

CHARACTER STUDIED	OFFSPRING OF				NET RESULT ON ALCOHOL OFFSPRING
	Treated ♂♂ × untreated ♀♀	Treated ♂♂ × treated ♀♀	All treated parents	Untreated controls	
1. Mean germ dosage index	137.8	299.0	210.35	0	
2. Percentage of infertile eggs (i.e., eggs in which no zygote was formed)	25.2	59.2	41.7	*25.3*	–
3a. Percentage of embryos dying in shell	36.6	*26.9*	33.3	42.2	+
3b. Percentage of fertile eggs (i.e., zygotes) which hatched	63.0	*72.3*	66.7	57.8	+
4. Percentage of all eggs which hatched	47.1	29.4	38.6	*44.4*	–
5. Percentage mortality under 180 days of age	21.1	*10.6*	17.6	36.9	+
6. Percentage mortality over 180 days of age	*5.9*	13.6	10.3	15.3	+
7. Sex ratio: per cent ♂♂	48.9	45.5	47.7	50.0	0
8. Mean hatching weight per bird, males	34.91	*36.97*		34.24	+
9. Mean hatching weight per bird, females	35.04	*37.17*		34.73	+
10. Mean adult weight per bird, males	2669	*2815*		2392	+
11. Mean adult weight per bird, females	2020	*2063*		1928	+
12. Percentage of weak or deformed chicks	0.7	*0*	0.4	1.0	+
13. Abnormalities of Mendelian inheritance	0	0	0	0	0

An examination of this table shows that *out of 12 different characters for which we have exact quantitative data, the offspring of treated parents taken as a group are superior to the offspring of untreated parents in 8 characters.* The offspring of untreated parents are superior to those of the alcoholists in respect of but two characters, and these are characters which are quite highly correlated with each other and really should be counted as but one single character. Finally with respect to two character groups there is no difference between the alcoholists and the non-alcoholists.

We may evaluate our results in general terms as follows:

1. There is no evidence that *specific* germinal changes have been induced by the alcoholic treatment, at least in those germ cells which produced zygotes.
2. There is no evidence that the germ cells *which produced zygotes* have in any respect been injured or deleteriously affected.
3. The results with poultry are in *apparent* contradiction to the results of Stockard and others with mammals. This contradiction is, however, probably only apparent and not real, paradoxical as such a statement may appear.
4. The results with poultry are in a number of important respects in essentially complete agreement with those of Elderton and Pearson[3] on parental alcoholism in man, and of Nice[4] in mice.

The interpretation of these results which seems to account best for all the facts is that the apparent discrepancy between avian and mammalian results is fundamentally due to a difference in degree of resistance of the germ cells to alcohol. Given the existence of variation in the vigor or resisting power of germ cells, which is certainly a fact, we have the necessary basis for the action of a selective agent. The hypothesis which we wish to suggest is that alcohol acts as such a selective agent upon the germ cells of alcoholized animals, eliminating the weak and permitting the survival of the vigorous and highly resistant.

Detailed evidence in support of this hypothesis is presented in the complete paper. The experiments are being continued.

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[1] Some account of this work has already appeared. Cf. Pearl, R., On the effect of continued administration of certain poisons to the domestic fowl, with special reference to the progeny, *Proc. Amer. Phil. Soc.*, **55**, 243–258 (1916).

[2] Cf. for summary and bibliography of earlier papers Stockard, C. R., and Papanicolaou, G., A further analysis of the hereditary transmission of degeneracy and deformities by the descendants of alcoholized mammals, *Amer. Nat.*, **50**, 65–88, 144–177 (1916).

[3] Elderton, E. M. and Pearson, K., A first study of the influence of parental alcoholism on the physique and ability of the offspring, *Eugenics Lab. Mem.*, **10**, 1–46 (1910). (Second edition.)

[4] Nice, L. B., Comparative studies on the effects of alcohol, nicotine, tobacco smoke, and caffeine on white mice. I. Effects on reproduction and growth, *J. Exper. Zöol.*, **13**, 133–153 (1912).